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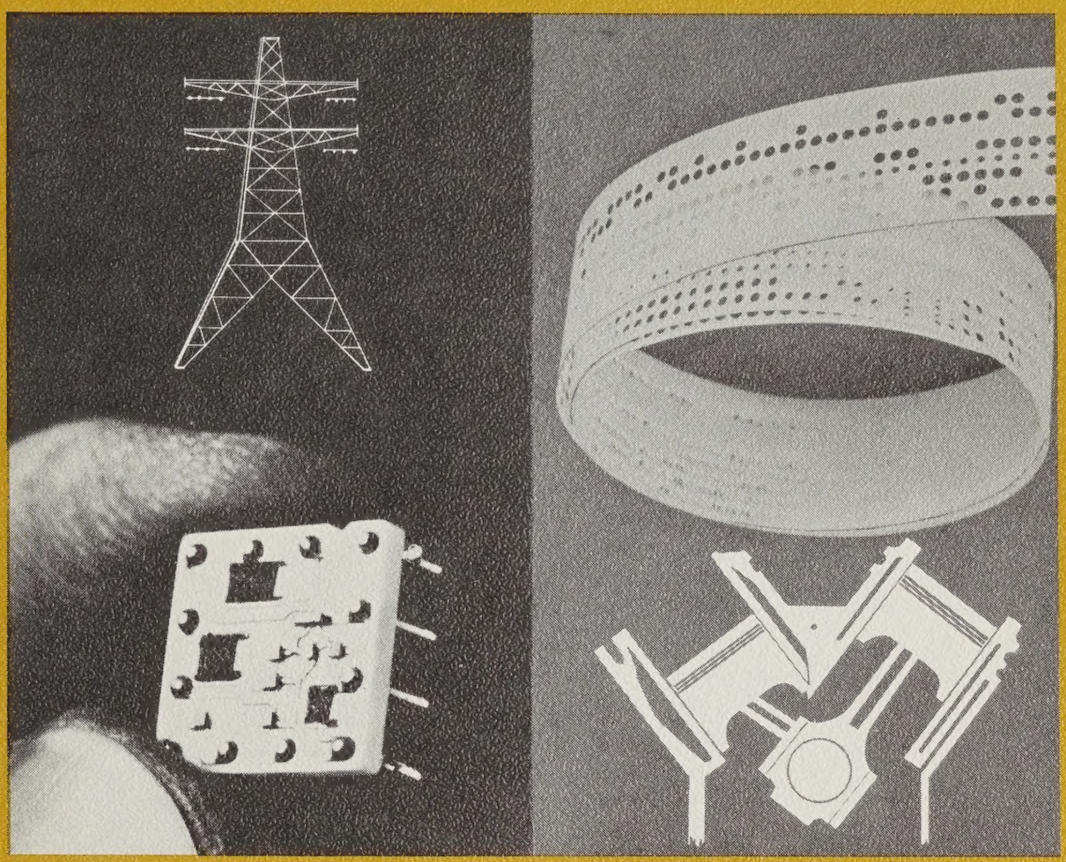

SCIENCE, TECHNOLOGY & TRADES

grades 10, 11 and 12 - volume 2

EDUCATIONAL TELEVISION SERIES 1967-68

Educational Television Branch
ONTARIO DEPARTMENT OF EDUCATION
1670 Bayview Avenue/Toronto 17

program schedule

SCIENCE, TECHNOLOGY AND TRADES

24 programs of 20 minutes each

PROGRAM NO.	CBC 9:40	CBC 9:30 REPEAT	CBOT 9:40	CHCH 9:40	CJOH CJSS	CKCO 9:00	CKCO 9:00 REPEAT
1	Oct. 16	Oct. 20	Oct. 17	Oct. 26	Oct. 19	Oct. 23	Oct. 27
2	Oct. 23	Oct. 27	Oct. 24	Nov. 2	Oct. 26	Oct. 30	Nov. 3
3	Oct. 30	Nov. 3	Oct. 31	Nov. 9	Nov. 2	Nov. 6	Nov. 17
4	Nov. 6	Not Shown	Nov. 7	Nov. 16	Nov. 9	Nov. 13	Not Shown
5	Nov. 13	Nov. 17	Nov. 14	Nov. 23	Nov. 16	Nov. 20	Nov. 24
6	Nov. 20	Nov. 24	Nov. 21	Nov. 30	Nov. 23	Nov. 27	Dec. 1
7	Nov. 27	Dec. 1	Nov. 28	Dec. 7	Nov. 30	Dec. 4	Dec. 8
8	Dec. 4	Dec. 8	Dec. 5	Dec. 14	Dec. 7	Dec. 11	Dec. 15
9	Dec. 11	Dec. 15	Dec. 12	Dec. 21	Dec. 14	Dec. 18	Jan. 12
10	Dec. 18	Not Shown	Dec. 19	Jan. 11	Dec. 21	Jan. 8	Not Shown
11	Jan. 8	Jan. 12	Jan. 9	Jan. 18	Jan. 11	Jan. 15	Jan. 19
12	Jan. 15	Jan. 19	Jan. 16	Jan. 25	Jan. 18	Jan. 22	Jan. 26
13	Jan. 22	Jan. 26	Jan. 23	Feb. 1	Jan. 25	Jan. 29	Feb. 2
14	Jan. 29	Feb. 2	Jan. 30	Feb. 8	Feb. 1	Feb. 5	Feb. 9
15	Feb. 5	Feb. 9	Feb. 6	Feb. 15	Feb. 8	Feb. 12	Feb. 23
16	Feb. 12	Not Shown	Feb. 13	Feb. 22	Feb. 15	Feb. 19	Not Shown
17	Feb. 19	Feb. 23	Feb. 20	Feb. 29	Feb. 22	Feb. 26	Mar. 1
18	Feb. 26	Mar. 1	Feb. 27	Mar. 7	Feb. 29	Mar. 4	Mar. 8
19	Mar. 4	Mar. 8	Mar. 5	Mar. 14	Mar. 7	Mar. 11	Mar. 15
20	Mar. 11	Mar. 15	Mar. 12	Mar. 28	Mar. 14	Mar. 25	Mar. 29
21	Mar. 25	Mar. 29	Mar. 26	Apr. 4	Mar. 28	Apr. 1	April 5
22	Apr. 1	Apr. 5	Apr. 2	Apr. 11	Apr. 4	Apr. 8	April 19
23	Apr. 8	Apr. 19	Apr. 9	Apr. 18	Apr. 11	Apr. 22	April 26
24	Apr. 22	Apr. 26	Apr. 16	Apr. 25	Apr. 18	Apr. 29	May 3

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IMPORTANT *PLEASE NOTE!*

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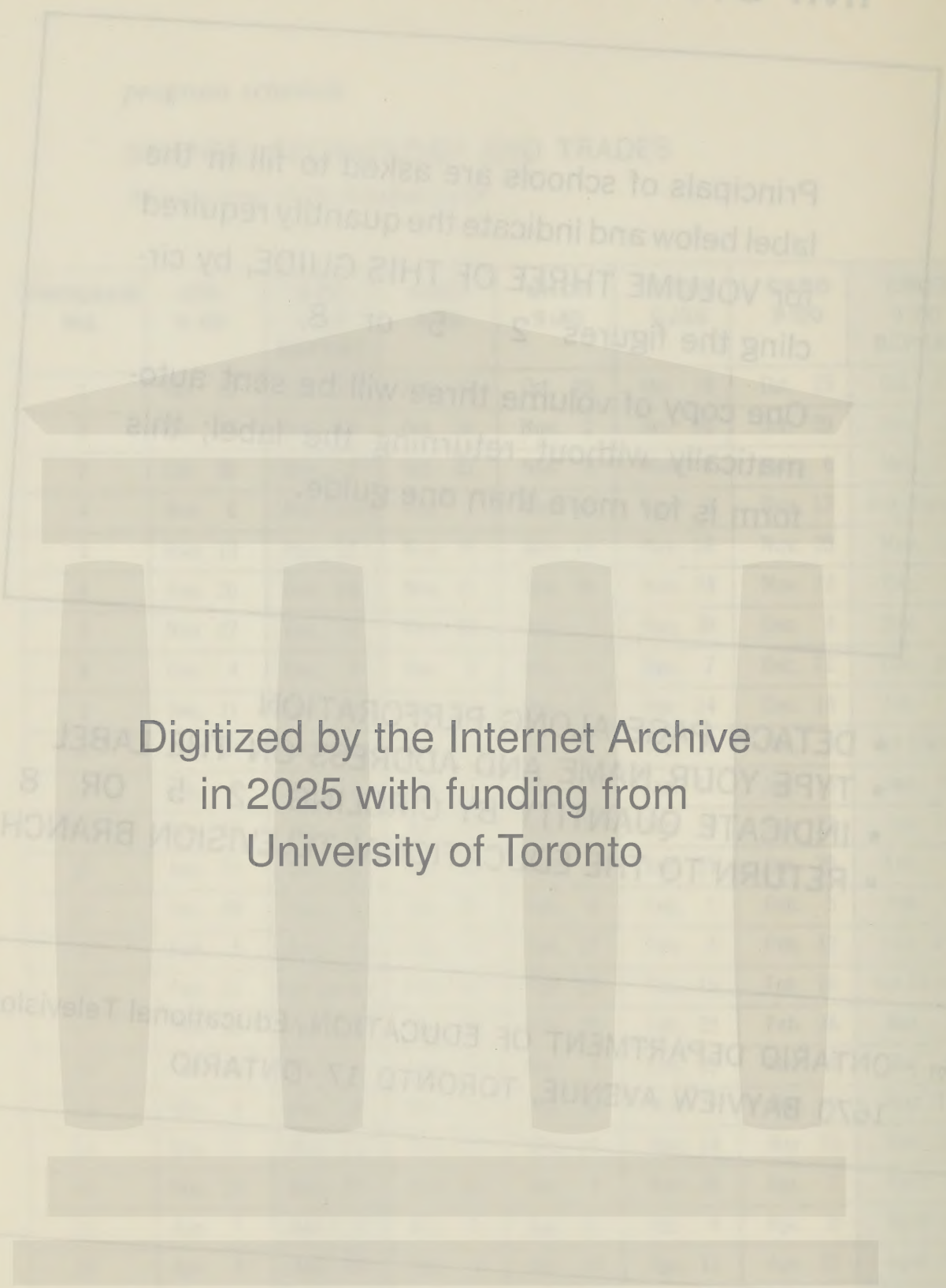

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SCIENCE, TECHNOLOGY AND TRADES — Volume 2

A series of 9 programs of 20 minutes each on Automotive Technology and Electrical Technology for students in grades 10, 11 and 12.

This is Volume 2 of a three-volume series. Programs 1 to 10 were contained in Volume 1.

contents

Program Schedule		inside front cover
General Introduction to Volume 2		2
Introduction to Automotive Technology		2
Program eleven	*Gasoline*	3
Program twelve	*Carburetion and the Fuel System*	4
Program thirteen	*Heat Engines*	4
Program fourteen	*The Measurement of Horsepower*	5
Program fifteen	*Application of the Chassis Dynamometer*	6
Introduction to Electrical Technology		8
Program sixteen	*Electrical Energy*	9
Program seventeen	*Microcircuitry*	9
Program eighteen	*Numeral Control Systems*	10
Program nineteen	*Laboratory Skills*	11
Optimum Viewing Conditions		inside back cover

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D. C. TORNEY

general introduction

This group of nine telecasts of the 1967-68 Science, Technology and Trades television series is composed of five programs on *Automotive Technology*, and four programs on *Electrical Technology*.

The programs were prepared with the assistance of practicing technical teachers in the appropriate specialties. They were made in close co-operation with industrial experts and where possible, at industrial locations.

It must be emphasized that the Science, Technology and Trades programs are intended as a stimulus to further detailed study conducted by the classroom teacher. They may serve as an introduction or a summation of a subject area but are not intended as single lessons.

Volume III will include two programs introducing *Industrial Chemistry*, two programs introducing *Industrial Physics* and one program explaining the *Integrated Course Concept*, as an expansion of the restructured Technical Courses for secondary schools.

introduction to Automotive Technology

This group of five programs is not an integrated series, although the programs are to a degree complementary. Once again the format is documentary. The treatment is purposely less formal that the preceding series. We hope that this will provide some variety for the students, while aiding us in establishing a format to use in presenting technical topics in the future. While the content of the programs may encompass some basic lessons in the Course of Study, the programs provide a basis for expansion by the teacher beyond it. The last two programs involve the use of the dynamometer as a practical diagnostic tool. An attempt was made to generalize on its operation because of the differences in the equipment of various manufacturers. Since the principal differences seem to be in the type and operation of the power absorption unit, the most common types are included. Although the level of sophistication is appropriate for grade 11 students, those in grades 10 and 12 will benefit from viewing these telecasts as well.

program eleven

GASOLINE

This program examines the most common engine fuel—gasoline, its physical and chemical properties, and its resulting behaviour in use in the internal combustion engine.

PROGRAM CONTENT

The opening sequence of this program demonstrates the need for vast quantities of gasoline as fuel for internal combustion engines in a variety of vehicles. This is followed by a brief explanation of fractional distilation of crude oil. It traces the sequence of production from the arrival of the crude oil at the refinery to the retail distribution of the product. In consequence of this, the chemical additives to the gasoline are examined as agents used to prevent engine "knock", etc. The operation of the four-stroke internal combustion engine is explained briefly. Common combustion faults such as detonation and pre-ignition are explored as to cause and effect. The program emphasizes that gasoline is a safe, convenient fuel if it is handled with sensible care.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Question the class as to the most common motive power in use. (This should lead to the internal combustion engine.) Establish the most common fuel used in internal combustion engines.
2. Establish the source of gasoline. Perhaps question the students to develop a concept of the refining process.
3. Discuss the necessity of additives to gasoline.

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss the refining of crude oil. Establish and correct, if necessary, the students' concept of fractional distillation, cracking (both thermal and catalytic) tetra-ethyl lead and the detergent additives. Note the care exercised in handling tetra-ethyl lead.
2. Explain that most additives are supplied to the oil companies as a single blending stock by the Ethyl Corporation or other chemical suppliers. The basic differences between gasoline brands lie in the additives, rather than the gasoline stock.
3. Discuss detonation and pre-ignition as to the causes, and damaging effects on the engine. Try to establish the difference between spontaneous detonation and pre-ignition due to *hot spots* in the combustion chamber.
4. Note that the term *octane* is not explained in the program. Possibly assign a homework question on this topic.
5. Discuss safety measures which should be observed in the handling of gasoline.
6. Assign a general research report on the oil refining process or smaller, more detailed reports on individual processes, e.g. catalytic cracking, reforming or isomers.

Note: A wealth of literature is available from the major oil companies which can be used as source material for research reports.

program twelve

CARBURETION AND THE FUEL SYSTEM

This program shows the preparation and control of the air fuel mixture and its flow to the internal combustion engine.

PROGRAM CONTENT

Through the media of film and limited animation the function of the carburetor is explained in detail. Each of the six major carburetor circuits is shown: the float circuit, the idle and low speed circuit, the high speed circuit, the accelerator pump circuit, the power circuit and the choke circuit. Fuel injection, multiple carburetor and multi-barrelled carburetor systems are introduced. The summation of the program traces the fuels' path from gasoline tank to the exhaust of unburned gases.

SUGGESTED PRE-VIEWING ACTIVITY

1. Review the characteristics of gasoline. Stress the necessity of an air fuel mixture in order to produce an explosive (sic. rapid, even-burning) mixture in the combustion chamber.
2. Demonstrate carburetion. A perfume atomizer may be used to show the mixture of air and fuel. (This more closely resembles fuel injection since the bulb acts as an air pump.)
3. Ask the class to list the main elements of the fuel system on the chalkboard.

SUGGESTED POST-VIEWING ACTIVITY

1. Discuss the *Bernoulli principle* and its application in the venturi of the carburetor.
2. Review the six carburetor circuits briefly.
3. Have the students explain each of the elements of the fuel system which were listed on the chalkboard prior to the telecast.
4. Assign a research report on one of these topics:
   a. Explain with diagrams any one of the six carburetor circuits. (Grade 10 if applicable).
   b. Multiple-carburetion—advantages and disadvantages
   c. Multi-barrel carburetion—advantages and disadvantages
   d. Fuel injection—advantages and disadvantages
   e. The Electric fuel pump vs. the Mechanical fuel pump

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program thirteen

HEAT ENGINES

This program shows that the energy generated by burning fuels, used to expand air, or gas, provides a power source for all heat engines.

PROGRAM CONTENT

The program opens with a brief historical examination of heat engines. The heat engine is defined as a mechanism which changes heat energy into mechanical energy. The elements of a heat engine are a source of heat (burning fuel) an expanding medium

(air or gases) and a mechanical device which utilizes the expanding medium to produce rotary or reciprocating movement. Each of the common heat engines is examined: the internal combustion engine, steam engines, the steam turbine, the diesel engine (both two-and four-stroke types) gas turbine engines (both jet and turbo prop) and the free piston engine.

SUGGESTED PRE-VIEWING ACTIVITY

1. Discuss the operation of the internal-combustion engine to establish that the hot expanding gases and air resulting from the burning of the fuel, provide the motive power of the piston. Establish that the internal-combustion engine is a heat engine; then ask the students to name some other heat engines. Possibly list these on the chalkboard.
2. Discuss various fuels which might be used to produce heat in heat engines. List these on the chalkboard.

SUGGESTED POST-VIEWING ACTIVITIES

1. Review the historical development of the various heat engines.
2. Examine each of the heat engines and their fuels, using the lists made up on the chalkboard prior to the program. You may wish to add nuclear-fission as a source of heat to drive steam turbines.
3. Discuss heat engines which were not included in the telecast, (e.g. the Wankel Internal-combustion engine).
4. Discuss the thermal efficiency of heat engines. Possibly assign a research report on this topic.
5. Possibly discuss Charles' Law as applied to the diesel engine.

Note: an excellent pamphlet, "The Story of Power" is available from the Public Relations Staff of General Motors Ltd., Detroit 2, Michigan, U.S.A.

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program fourteen

THE MEASUREMENT OF HORSEPOWER

This program defines horsepower and demonstrates how it may be measured.

PROGRAM CONTENT

James Watt's experiment is described in which he established a standard measure of horsepower by the empirical method. A simple problem is used to demonstrate how horsepower is calculated, based on Watt's formula. This is followed by an examination of the *Prony brake* as a laboratory apparatus to measure the horsepower produced by relatively low-power rotating mechanisms. The formula which utilizes the information obtained through the use of the *Prony brake* is developed. The engine dynamometer is introduced as a means of measuring the horsepower output of high-powered engines. The generator type engine dynamometer is shown to use the generator as an absorption

unit, being driven by the engine under test. The electrical output of the driven generator in watts, can be translated into brake horsepower. The water-brake dynamometer which employs a hydraulic absorption unit is described in detail. Both types of torque arm linkage, weight scale arm and electrical bridge, are also described.

The last segment of the program explains the use of the chassis dynamometer to measure the efficiency of the power train, that is, the horsepower delivered to the driving wheels of the vehicle.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Discuss the meaning of the term *power* in relation to *work*. Explain that power is a measure of the rate of doing work. Establish that *horsepower* is a unit of power, that is, a specific amount of work done in a specific time. Power equals work x time *or* since work equals load x distance, power equals load x distance x time.
2. Question the class to establish why the measure of power is called *horse*-power.

SUGGESTED POST-VIEWING ACTIVITY

1. Review the concept of *power*. Possibly demonstrate Watt's formula with a simple problem.
2. Explain the term *torque*. Show how the *Prony brake* and the water absorption unit of the dynamometer utilize the turning movement of the *torque arm*.
3. Explain the difference between the various horsepower ratings of engines (e.g. brake horsepower, SAE horsepower, and licence horsepower).
4. Demonstrate the measurement of horsepower on the automotive shop dynamometer if available.
5. Assign a research report on the various makes of dynamometer; (e.g. Maxwell, Clayton, Bear, etc.), with particular emphasis on their absorption units.

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program fifteen

APPLICATION OF THE CHASSIS DYNAMOMETER

This program demonstrates the use of the chassis dynamometer as a simulator which in conjunction with other analytical instruments provides an effective means of trouble diagnosis in the automotive shop.

PROGRAM CONTENT

The opening sequence demonstrates that to be sure that an automobile is functioning properly a diagnosis on a dynamometer is much safer than a road test. The program shows step by step how the performance of a vehicle can be checked and faults located and corrected under "road test" conditions in the automotive shop. This is accomplished through the use of the roll-type chassis dynamometer and its auxiliary instruments. Standard tests are explained as they are carried out by mechanic-technicians. Some of the tests are explained in detail while others are given a more cursory treat-

ment. It should be noted that some of the tests will vary with the capability of the equipment available from a variety of manufacturers. However, an attempt has been made to emphasize those tests which may be carried out using common types of equipment available in industry and the automotive classroom.

SUGGESTED PRE-VIEWING ACTIVITY

1. Question the students to generate the idea that the roll-type chassis dynamometer might be used to duplicate road conditions in the automotive shop.
2. Discuss the *diagnostic centres* as a recent development in the automobile service centres. Introduce the chassis dynamometer as the principal equipment used in these centres.

SUGGESTED POST-VIEWING ACTIVITY

1. Discuss the relative merits of road testing and dynamometer testing of vehicles. Emphasize safety.
2. Discuss in detail the various standard tests which may be carried out using the chassis dynamometer and allied equipment. (Information is available from any analytical equipment manufacturer.) Emphasize the function of the dynamometer as a simulator.
3. Arrange a tour of a local diagnostic centre and assign a research report of the tour.
4. Demonstrate the use of the dynamometer and its auxiliary instruments in the automotive shop. Point out the differences (if any) in your equipment from that shown in the telecast. Discuss the relative merits of each type.

introduction to Electrical Technology

As the titles of the four programs prepared on *Electrical Technology* indicate, this group of telecasts does not constitute a series. Each program deals with a single topic which should prove of interest to technical students. They were filmed on location at various power stations, factories, and laboratories. The programs are diverse because they are attempts to present individual topics which are somewhat difficult to present in the classroom. Program 17 and 18 (*Microcircuitry and Numerical Control Systems*) will require considerable preparation by the students and careful attention during the telecasts. Both of these subjects are relatively difficult to understand without prior instruction. They are suitable for grade 11 and 12 technical students. Programs 16 and 19 will be beneficial to all grades.

program sixteen

ELECTRICAL ENERGY

The telecast shows the way in which large blocks of electrical energy are produced, transferred, controlled, and consumed.

PROGRAM CONTENT

From Michael Faraday's first generator to the nuclear power station at Douglas Point, this program shows the development of hydro-electric and thermal-electric generating. Turbines driven by water and steam produce vast amounts of electrical energy which must be transported from the point of generation to the point of consumption. This program traces the path taken by electrical energy through step-up transformers, and high voltage transmision lines which makes up the international grid system, through control centres, and switch gear, through local substations and step-down transformers, and thence to the consumer. Each step along this path is explained in some detail. Wherever possible, the program shows actual electrical installations.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Point out to the students that the program uses a *system approach* in its examination. The interest is in the system—what each component *does* rather that *how* each component performs.
2. Discuss the impact that the availability of electrical energy has on our daily living; e.g. what would life be like without electrical energy?
3. Ask the pupils how electrical energy is produced. List their answers on the chalkboard. Compare the capabilities of each method; e.g. battery, photo voltaic cell, piezo-electric effect, turbo-generators.
4. Prepare an unlabelled block diagram to accommodate the various components of power generation, etc., on the chalkboard or as a fill-in instruction aid sheet.

SUGGESTED POST-VIEWING ACTIVITIES

1. Fill in the block diagram on the chalkboard by questioning the students. Perhaps have them list various types of generating plants, switch gear, transmission lines, etc. Possibly utilize a fill-in IAS as a test or home work assignment.
2. Assign a research report wherein each student or group would gather statistical information on an individual power plant or local sub-station.

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program seventeen

MICROCIRCUITRY

This program explains the meaning of microcircuitry and shows the development, applications and advantages of micro-miniaturized circuits, with particular attention to micromodules, thin films and integrated circuits.

PROGRAM CONTENT

The initial sequence in this program points out the advantages of microcircuitry: cheap and easily obtained materials, mass production fabrication techniques, mobility, portability, limitation of environmental stresses due to size, extremely rapid inter-

action of components, reliability, efficiency, function life, the possibility of incorporating redundant circuits without an appreciable increase in size, and finally, a reduction in cost. This sequence is followed by simple descriptions of micromodules, thin film and integrated circuits. The basic steps in the manufacture of these components are shown with the greatest emphasis on integrated circuits.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Discuss the terms
   — single discrete component transistor
   — micro-miniaturization
   — micro-module
   — integrated circuit
   — redundant (or back-up) circuits
2. Explain *diffusion*, *sputtering*, and *photo engraving*.

SUGGESTED POST-VIEWING ACTIVITIES

1. Recall specific advantages of miniaturization.
2. Distinguish between micromodule (stacked), thin film (deposited), and integrated (photo engraved and diffused).
3. Discuss the effect of integrated circuits on the knowledge and technical activities of the technician. Perhaps assign an essay on this topic.

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program eighteen

NUMERAL CONTROL SYSTEMS

The purpose of this program is to describe and explain numerical control systems, and to investigate a typical unit used to control a machine tool.

PROGRAM CONTENT

Numerically controlled machines are presented as a unit not restricted to mass production, designed instead to do small-lot precision work. The advantages of numerical control of machines are examined in some detail. The development of numerical control is traced from Joseph Jacquard's punch card controlled weaving machine through the player piano to the beginning of modern numerical control at the Massachusetts Institute of Technology in 1952. The basic units of a numerical control unit: the decoder, the information storage, the servo units, gauging devices and feed back comparator, are examined and their functions are explained. Basically, input, central processing unit, and an output are the components of the numerical control unit. Taper readers or sensing devices of various types are mentioned but the punched paper or "mylar" tape unit is examined as typical. The examination of a program prepared from drawings or specifications, its translation to eight column tape, and its eventual use in the control unit activating the servo-systems which regulate the movements of the machine-tool platen or spindle, completes the telecast.

SUGGESTED PRE-VIEWING ACTIVITIES

1. It is essential that the students understand the *binary system* in mathematics if they are to understand the basic concepts of the content of this program. *This system should be reviewed prior to the program.*

2. Discuss bistable devices as incorporated in computers.
3. Perhaps recall program 5 of the *Mechanical Technology* series. One segment of this program gave a cursory examination of numerical control.
4. Perhaps place an unlabelled block diagram of a simple numerical control system on the chalkboard to be labelled by the students after viewing the program.

SUGGESTED POST-VIEWING ACTIVITIES

1. Complete the block diagram. *See page 12 for diagram.*
2. Initiate a discussion on the rate of introduction of numerical control systems in the manufacturing industry. *If* it is generally conceded that the rate is *slow* try to establish the reasons for this.
3. Assign a research report on either the numerical control system or its individual components. Perhaps have the best reports presented to the class as papers. Insist that the students be prepared to answer questions from the class.

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program nineteen

LABORATORY SKILLS

This program demonstrates that the laboratory skills developed in the school are identical with those required by industry.

PROGRAM CONTENT

This program compares the laboratory skills practiced in school by a student, with those required upon his graduation and subsequent employment as a technician in industry. The areas of employment requiring skilled technicians are examined. The skills of the technician are outlined and related with those which should be learned in the electrical classroom. These include physical dexterity, the utilization of technical knowledge, the ability to communicate both orally and in written reports, and to work effectively while observing good safety practices.

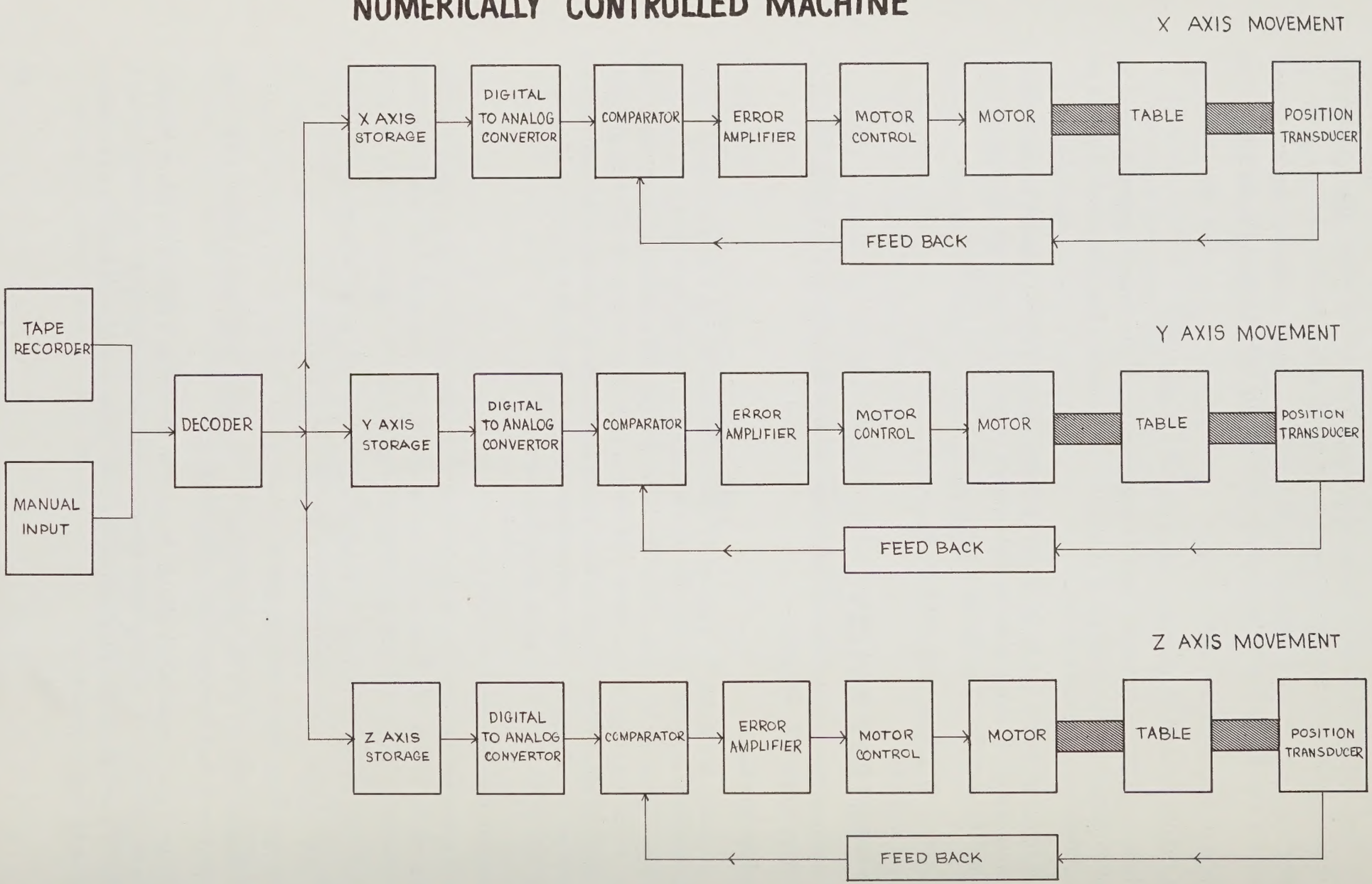
SUGGESTED PRE-VIEWING ACTIVITY

1. Question the class to obtain the students' concepts of laboratory skills. Possibly list these on the chalkboard. It might prove interesting to list other qualities expected in industrial technicians e.g. (integrity in recording results, attitudes etc.).
2. Attempt to list the areas of employment where electrical laboratory skills are required (e.g. research, inspection, quality control, etc.).

SUGGESTED POST-VIEWING ACTIVITIES

1. Examine the list on the chalkboard to compare those skills listed with those mentioned and demonstrated in the telecast.
2. Discuss the format which should be used in preparing a technical report. Perhaps have the students develop their own formats in writing up a simple experiment. The reports should be presented to the class upon completion for critical examination by fellow students.

SIMPLIFIED BLOCK DIAGRAM OF A TYPICAL NUMERICALLY CONTROLLED MACHINE



FOR OPTIMUM VIEWING CONDITIONS

1. Review Teachers Guide well in advance of each telecast.
2. Have the set on and adjusted, sound off before the program begins.
3. Have suggested materials ready.
4. Be sure that you can observe both the program and your students' reactions during the telecast.
5. Assure student comfort by
   — locating the set for best viewing,
   — eliminating glare and reflection,
   — ventilating room properly,
   — placing seats within 20′ of the screen.

This diagram shows the suggested placement of the television set: